DOCUMENT RESUME

ED 441 405 IR 057 676

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TITLE	How To Put Your Maps on the Internet.
PUB DATE	1999-08-00
NOTE	7p.; In: IFLA Council and General Conference. Conference Programme and Proceedings (65th, Bangkok, Thailand, August 20-28, 1999); see IR 057 674.
AVAILABLE FROM	For full text: http://www.ifla.org/IV/ifla65/papers/018-94e.htm.
PUB TYPE	Reports - Descriptive (141) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Electronic Libraries; Information Technology; *Maps; Optical Scanners; *World Wide Web
IDENTIFIERS	Data Compression; *Digital Imagery; Metadata; Web Sites

ABSTRACT

Many libraries are creating raster images of paper maps and making them available over the Internet. This presentation provides an overview of imaging technology for map librarians and administrators considering such projects. References in footnotes and the bibliography enable those interested to explore technical questions in depth. There are several approaches to digitizing and distributing raster images of maps on the Internet. Acceptable work for some purposes can be accomplished with very little expense or staff time. Producing high quality images of large maps, however, involves considerable commitments of time and money. Available technologies for digitizing maps include scanning from film (such as the Kodak Photo CD process), use of flatbed scanners, and high-end digital cameras. The advantages and disadvantages of these methods are discussed. Suggested images of large maps require very large data files, and methods of compressing and distributing these files are described. The importance of creating metadata that can be searched on the World Wide Web is also stressed. (Contains 15 Internet resources and 12 notes.) (Author/MES)

IFLANET
Search Contacts
International Federation of Library Associations and Institutions
Annual Conference

65th IFLA Council and General Conference

Bangkok, Thailand,
August 20 - August 28, 1999

Conference Proceedings

Code Number: 018-94-E
Division Number: II
Professional Group: Geography and Map Libraries
Joint Meeting with: -
Meeting Number: 94
Simultaneous Interpretation: *No*

How to Put Your Maps on the Internet

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Abstract

Many libraries are creating raster images of paper maps and making them available over the Internet. This presentation is intended to provide an overview of imaging technology for map librarians and administrators considering such projects. References in footnotes and a bibliography will enable those interested to explore technical questions in depth.

There are several approaches to digitizing and distributing raster images of maps on the Internet. Acceptable work for some purposes can be accomplished with very little expense or staff time. Producing high-quality images of large maps, however, involves considerable commitments of time and money. Available technologies for digitizing maps include scanning from film (such as Kodak Photo CD process), use of flatbed scanners, and high-end digital cameras. The advantages and disadvantages of these methods are discussed. Suggested guidelines for producing image files suitable for research are presented. High resolution images of large maps require very large data files, and methods of compressing and distributing these files are described. The importance of creating metadata that can be searched on the World Wide Web will also be stressed

Paper

How to Put Your Maps on the Internet

This presentation is intended as a non-technical overview. My purpose is to encourage those of you who have not done so to make parts of your map collections available on the World Wide

Web. The written version of this paper is accompanied by footnotes and a list of Web sites for those who want to explore the technical issues in depth.(1) I would also be glad to discuss specific questions with you at any time during this conference, or answer them by e-mail after the conference.

I will focus primarily on creating images of historical maps, although the techniques I will be describing can also be used to digitize topographic maps, aerial photographs, and satellite images. So far almost all of the projects involving the digitization of antique maps have been done in North America and Western Europe. There is no reason why similar projects cannot be carried out elsewhere. It would truly be a wonderful contribution to both scholarly research and cultural understanding if high-resolution images of the world's cartographic treasures could be viewed by anyone with a connection to the Internet.

Historical maps must be digitized as raster images.(2) Raster images have become increasingly important in the world of digital mapping in the last few years. Ordinarily when you think of digital mapping, what comes to mind is geographic information systems (GIS), which are best known for their ability to manipulate vector images. Raster images, however, are appearing more and more frequently on the Internet, and most leading GIS software programs have also become quite good at working with raster as well as vector images.

There are several reasons why we are seeing more raster images. A major drawback of raster images has been their enormous file size, which made it almost impossible to work with them using ordinary computers, or to transmit them over the Internet. An uncompressed raster image of a medium-sized colored map can easily occupy several hundred megabytes. A number of developments in the last few years have made working with files this size practicable. These include the increasing power of reasonably priced personal computers, the availability of inexpensive mass storage, the development of new file compression techniques, and the invention of new ways to transmit large files over the Internet.

It is possible to get started putting maps on the Internet with a very small investment in training or money. All you really need is access to a server, and an ordinary PC equipped with a small amount of additional software and hardware. If you don't have much experience with computers, it is probably best to start out small. The drawback of this low-cost approach is that you will have to settle for digitizing very small maps, or else for producing low-resolution images. A small map of--say, 20 x 30 cm.--can be scanned using an ordinary commercial scanner, compressed using JPEG (a public domain program), and served up on the Web for all to see.(3) Larger maps can be photographed on 35 mm. slides, and digitized at a reasonable cost using a process such as Kodak Photo CD.(4) Images of ordinary sized maps produced from slides will not, however, have adequate resolution to capture all of the details on the map.

Producing research quality images of medium-sized or large maps is much more difficult and expensive. It is nonetheless within reach of most large libraries, such as national libraries and many museum and university libraries. So far most of the work of this type has been done in the United States, with the Library of Congress Geography and Map Division leading the way. These libraries have been the pioneers, and in the remainder of this paper I will outline what needs to be done to produce comparable images.(5)

There is an emerging consensus that maps need to be digitized at a minimum of about 300 dpi in 24 bit color if all the important details are to be captured. (The requirements for black and white maps are somewhat different.) An uncompressed image file of even a relatively small map (say 60 by 90 cm.) Will occupy several hundred megabytes. In order to make such a map available on the Internet, a sequence of steps has to be followed: the map has to be digitized, the uncompressed files need to be stored, the files need to be edited and compressed, the compressed files need to be placed on a server, and metadata needs to be created to make the maps known to the world.

The most difficult part of this process is digitizing the map. Here you have essentially three

options: digitizing from film, using a scanner, or using a digital camera. Digitizing from film produces the least satisfactory results, but it is also the easiest and least expensive method for those that have small numbers of maps to digitize. The procedure involves taking 4 x 5" or even 8 x 10" photographs and sending the negatives or transparencies to a service bureau to scan them. The drawbacks in working with a film intermediary are that there are unavoidable losses in resolution and color fidelity in comparison with other methods. Nonetheless, it is possible in this way to get reasonably good results for many purposes with a relatively small investment..

Scanners produce better results, but are limited by the size of the maps they can handle. There are a few scanners that can work with large maps. The Library of Congress is using an expensive flatbed scanner produced by the Tangent Imaging Systems for its Panoramic Map digitization project.(6) The Library of Congress obtained its scanner as a donation. Cost and some technical considerations make it doubtful whether many libraries will want to imitate the

Library of Congress in this respect, although they have obtained excellent results using this scanner. For those who prefer to work with scanners, sheet-feed scanners are a less expensive option, although they are not suitable for rare or fragile materials.(7).

In my opinion, high-end digital cameras are presently the best option for those contemplating creating large numbers of research quality map images. A device like the Phase I Power Phase FX digital camera back for 4 x 5" view cameras can create images up to 10,500 x 12,600 pixels in 24 bit color. At this resolution one can digitize maps up to 35 x 42 inches at 300 dpi.(8) The total cost of a digital camera back and associated equipment is somewhat lower than that of a Tangent scanner. Digital cameras also reportedly have better color fidelity than scanners, and can work with three dimensional objects, such as bound atlases. They can be used with a variety of types of art as well as maps.

Once you have created digital images of your maps, the other problems are relatively easy to solve. The uncompressed images can be stored on CDs. Before compressing the images, you will probably want to crop and edit them using a program like Adobe Photoshop. The resulting images can be distributed on CDs or DVDs. If you want to put your maps up on the Internet, you can create low resolution copies and compress them using JPEG. If you want to put up high quality images on the Internet, you will have to use a specialized program like MrSID.(9) This program, which is used by the Library of Congress, uses special compression techniques to obtain a higher level of compression with good image quality than can be obtained by using JPEG. It also allows users to zoom in on images. Because MrSID never transmits more of an image than can be actually viewed on a computer screen, it makes it possible to view large digital files without transmitting more than a small portion of them at one time over the Internet.

I would like to conclude with a word about metadata. It is not enough just to put up images of your maps on the Internet. You also need to provide some bibliographic information, and you need to enable people to find them on the Internet. Most of us have been rather casual about furnishing this information , and have made do with providing a minimal amount of bibliographic data (author, title, date of publication of the original map) along with the images. If collections of digital images reflect a specific geographic area, this approach works tolerably well, and the maps can be located by using tools such as Odden's bookmarks.(10) But this is not a satisfactory solution in the long run. We need a single database of all the digital maps in the world, which could be searched by author, title, keyword, and other parameters. Map librarians are only now starting to grapple with this problem, and information about these ongoing efforts can be found on the Web.(11) At least for historical maps, I expect that we will want to adopt an approach similar to the OCLC CORC project, which involves the creation of a Web searchable database combining standard MARC cataloging records with "Dublin Core" brief cataloging.(12)

NOTES:

1. For a more technically oriented overview of the subject of this paper see David Yehling Allen, "Creating and Distributing High Resolution Cartographic Images," RLG DigiNews, Vol. 2, No. 4 (August 15, 1998), 1-6 http://www.rlg.org/preserv/diginews/diginews2-4.html. This article contains links to many of the most important sites concerned with imaging cartographic materials.

Additional information can be found in Issue No. 12 (1997) of Meridian (the Journal of the Map and Geography Round Table, American Library Association). This entire issue is devoted to digital imaging of maps; footnotes to the articles in that issue provide access to most of the relevant literature.

2. Raster images are formed from a grid of rectangular "pixels." Vector images are created from mathematically defined lines and curves. Vector maps created by GIS programs can also be put on the Internet using programs such as ESRI's ArcView Internet Map Server.

3. One of the most prominent sites that has put up large numbers of scanned images of small maps is the Perry-Castañeda Library Map Collection at the University of Texas at Austin http://www.lib.utexas.edu/Libs/PCL/Map_collection/Map_collection.html. An ingenious example of what can be done using very low tech equipment is the Historic USGS Maps of New England collection at the Diamond Library of the University of New Hampshire http://docs.unh.edu/nhtopos/nhtopos.htm. These map images were scanned in sections by a researcher using a laptop computer and a handheld scanner. Although there are many interesting technical problems with the images (such as moiré effect), they are nonetheless usable for many research purposes.

4. On Photo CD see David Yehling Allen, "Digital Imaging for the Rest of Us: Kodak Photo CD and Kodak Pro Photo CD," Meridian No. 12 (1997), 15-18.

5. The URL for the Library of Congress Geography and Map Division is: http://lcweb2.loc.gov/ammem/gmdhtml/gmdhome.html.

6. The flatbed scanner made by Tangent Imaging Systems (a division of Scangraphics Corporation) can scan maps up to 24 x 36" in size. Information is available at http://www.colorscan.com.

7. The National Archives of the United States used a color roller scanner made by Anatech Corporation for digitizing its Historical Map and Chart Collection. See: http://chartmaker.ncd.noaa.gov/ocs/text/MAP-COLL.HTM

8. Information on the Phase I PowerPhase FX can be obtained at: http://www.phaseone.com. See also, Peter B. Hirtle and Carol De Natale, "Selecting a Digital Camera: the Cornell Museum Online Project," RLG DigiNews, Vol. 2, No. 6 (Dec. 15, 1998)http://www.rlg.org/prserv/diginews2-6.html#technical1

9. MrSID is created by a company called LizardTech http://www.lizardtech.com. See also Steven Puglia, "Fractal and Wavelet Compression," RLG DigiNews, Vol 2, No. 3 (June 15, 1998)http://www.rlg.org/preserv/diginews/diginews23.html#technical2

10. The URL for Odden's Bookmarks is: http://kartoserver.frw.ruu.nl/HTML/staff/oddens/oddens.html.

11. For information on metadata, see the American Library Association, Map and Geography Round Table, "Metadata Primer for Map Librarians" http://www.sunysb.edu/libmap/metadata.htm. For a more technical introduction to metadata from an international perspective see Jan Smits, "The Creation and Integration of Metadata in Spatial Data Collections,"prepared for the 63rd IFLA Conference, Copenhagen, Denmark (18

August, 1997)http://magic.lib.uconn.edu/ifla/meta-smits.htm.

12. For the Dublin Core see: <http://Purl.oclc.org/dc/. For the CORC Project see: http://www.oclc.org/oclc/research/projects/corc/index.htm.

How to Put Your Maps on the Internet: Sources of Information

General Information on Digital Imaging

1. Besser and Trent, "Introduction to Imaging" <http://www.ahip.getty.edu/intro_imaging>. (Good on basics).

2. David Yehling Allen, "Creating and Distributing High Resolution Cartographic Images"<http://www.rlg.org/preserv/diginews2-4.html >

(Comprehensive introduction with links to many sites)

Sites with Digital Images of Maps

1. Perry-Casteñada Map Library at the University of Texas at Austin <http://www.lib.utexas.edu/Libs/PCL/Map_collection/Map_collection.html>

(Many small maps scanned with desktop scanner)

2. Historic USGS maps of New England <http://docs.unh.edu/nhtopos/nhtopos.htm>

(Maps scanned in sections with hand-held scanner.)

3. Library of Congress, Geography and Map Division <http://lcweb2.loc.gov/ammem/gmdhtml/gmdhome.html>

Photo-CD, Scanners, and Digital Cameras

1.Anne R. Kenney and Oya Y. Rieger, "Using Kodak Photo CD Technology for Preservation and Access: A Guide for Librarians, Archivists and Curators" <http://www.library.cornell.edu/preservation/kodak/cover.htm>

2. Tangent scanners: <http://www.colorscan.com>

3. Phase I digital cameras: <http://www.phaseone.com>

4. Peter B. Hirtle and Carol de Natale, "Selecting a Digital Camera: the Cornell Museum Online Project," RLG DigiNews, Vol. 2 , No. 6 (Dec. 15, 1998) <http://www.rlg.org/preserv/diginews/diginews2-6.html#technical1>

Software for Compressing and Distributing Images

1. MrSID: <http://www.lizardtech.com>

2. Steven Puglia, "Fractal and Wavelet Compression," RLG DigiNews, Vol. 2, No. 3 (June 15, 1998) <http://www.rlg.org/preserv/diginews/diginews23.html#technical2>

Metadata

1. Odden's Bookmarks: <http://kartoserver.frw.ruu.nl/HTML/staff/oddens/oddens.html>

2. American Library Association, Map and Geography Round Table, "Metadata Primer for Map Librarians": <http://www.sunysb.edu/libmap/metadata.htm>

3. Dublin Core homepage: <http://Purl.oclc.org/dc/>

4. CORC Project: <http://www.oclc.org/oclc/research/projects/corc/>.

Latest Revision: *June 2, 1999*

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
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